

# Obstetric anaesthesia practice: Dashboard as a dynamic audit tool

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## ABSTRACT

Rapid advances and improved networking abilities have led to the widespread adoption of technology in healthcare, especially focused on diagnostics, documentation and evaluation, or mining of data to improve outcomes. Current technology allows for rapid and accurate decision-making in clinical care decisions for individual patients, collation and analysis at different levels for administrative and financial purposes, and the ability to visualise, analyse, and share data in real time for departmental needs. The adoption of technology may help to improve efficiency and efficacy of healthcare services. Obstetric anaesthesia is a specialised area that has to address the well-being of the pregnant woman and the unborn baby simultaneously. A shift toward caesarean sections as the major mode of childbirth has led to an increased involvement of anaesthesiologists with childbirth. Decisions are often made in high pressure, time intense situations to protect maternal and foetal health. Furthermore, labour analgesia using various neuraxial and non-neuraxial techniques is being demanded by parturients frequently, and for the materno-foetal safety, risk management is the core issue. Hence, it is essential that obstetric anaesthesia teams regularly audit their outcomes to improve services and to identify potential trouble spots earlier. It may be helpful to have audit parameters displayed as visual data, rather than complex tabular and numerical data, for ease of sharing, analysis, and redressal of problem areas. We describe the design and use of an obstetric anaesthesia dashboard that we have used in our department for the past 5 years.

**Key words:** Anaesthesia outcomes audit, dashboard, maternal and foetal safety

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## INTRODUCTION

Clinical practice units, teams, and hospitals are increasingly relying on electronic medical records to collect, store, retrieve, and analyse patient-related data.<sup>[1-6]</sup> Electronic Health or Medical Records (EHMRs) are designed to improve efficacy and efficiency of care at every point of care, across disciplines, and are no longer restricted to static data. EHMR allows for the validation and analysis of data pertaining to patient safety, outcomes, adherence to protocols or evidence-based guidelines, assessment of risk, and analysis of processes and policies pertaining to clinical care quality.<sup>[7-9]</sup> EHMR can lead to the generation of extensive data, both quantitative and qualitative, and may lead to extremely large data files for each individual. However, the purpose of

the EHMR is partially lost if clinicians are unable to visualise, retrieve, synchronise, and examine more closely relevant pieces of information in real time to help with optimal patient care. Technical advances in computing and networks have improved the capability to synchronise patient data and perform clinically meaningful problem-solving analysis in real time. The integration of patient information into a dashboard

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display may help to assess information more rapidly, streamline processes, reduce response times, and reduce errors of oversight in clinical care.<sup>[10-14]</sup>

Obstetric anaesthesia is a specialised practice within anaesthesia that has to simultaneously monitor the health of two or sometimes three individuals—the pregnant mother and the growing foetus or baby. The practice of obstetric anaesthesia involves the evaluation of the pregnant mother including risk assessment for both the mother and foetus, a multidisciplinary approach that involves close liaison with the obstetrician, internist, neonatologist, and other specialties of care. The obstetric anaesthesiologist has to simultaneously consider several parameters including physiological parameters for maternal and foetal well-being assessment, maternal morbidity and their potential impact on foetal well-being, interventions to deliver the baby, short-term and long-term impact on the new born babies, short-term and long-term impact on the well-being of the mother, and potential impact on reproductive health and subsequent pregnancy for the mother. These assume particular significance in a country like India that has a large number of childbirths by caesarean sections and significant maternal morbidity with a potential for maternal, foetal, neonatal, and infant mortality.<sup>[15]</sup>

In this narrative review, we discuss the development and use of an obstetric anaesthesia dashboard with particular focus on clinical risk assessment and management that not only provide optimal outcomes but also serves as a dynamic quality enhance tool for each anaesthetic rendered during pregnancy.

## PERINATAL HEALTH AND OBSTETRIC ANAESTHESIA IN INDIA

Maternal mortality rates remain relatively high in India although there is a declining trend in recent years.<sup>[15]</sup> A significant proportion of pregnant women in India are affected by various maternal morbidities, especially undernourishment, anaemia, hypertensive disorders of pregnancy, and diabetes. These maternal morbidities affect maternal health, the potential for a normal, safe childbirth and the well-being of the growing foetus as well as new born babies. The shift toward institutionalised perinatal care has resulted in a larger proportion of women receiving specialised childbirth care including caesarean sections and assisted vaginal deliveries, options for painless or pain managed childbirth, and improved neonatal

care, which has helped in better maternal, neonatal, and infant well-being. The National Family Health Survey-4 (NFHS-4) from India (2015-16) reported that infant mortality rates reduced from 57 (NFHS-3 done in 2005-06) to 41 per 1,000 live births.<sup>[15]</sup> The NFHS-4 also reported an increasing uptake of antenatal services compared to NFHS-3.<sup>[15]</sup> The proportion of women who had at least four antenatal care visits increased to 51.2% from the 37.0% reported in NFHS-3. Institutional births increased from 38.7% to 78.9% and childbirths by caesarean sections increased to 17.2% from the 8.5% during the same period.<sup>[15]</sup> The maternal mortality rates (per 100,000 live births) have also shown a decline from 254 in 2004-06 to 167 in 2011-13.<sup>[16]</sup>

The potential to involve obstetric anaesthesiologists earlier in the childbirth planning process is a benefit of institutional deliveries. Obstetric anaesthesiologists can be involved during antenatal care to develop an individualised childbirth plan that considers the maternal and foetal well-being. However, several challenges remain for the provision of optimal anaesthesia care, including late referrals for emergency childbirth, and incomplete documentation or lack of access to prior medical records.

Improvements in perinatal outcomes involve each discipline associated with pregnancy and childbirth auditing and evaluating processes, procedures, and outcomes pertaining to their disciplines. The audit can help to identify problem areas and to develop strategies to address specific problems. The audit has several other benefits including the ability to share information within the obstetric anaesthesia team and across other disciplines involved with childbirth, to monitor processes and outcomes in real time, and to evaluate trends in care indicators over a longer period of time.

## THE USE OF DASHBOARDS TO AID INTERPRETATION OF DATA

There is an increasing recognition of quality metrics as indicators of care outcomes. Although a vast variety of data can be collected, quality metrics prioritise and focus on important indicators that can influence the process and outcomes of care. However, evaluation of these metrics may be time intensive and may require extensive chart reviews to collect pertinent information. Dashboards are increasingly used to provide data, even in real time, on quality

metrics.<sup>[10-14]</sup> Dashboards provide a user interface that can be used to retrieve and analyse, in a single screen, information pertinent to the clinical care of a single patient.<sup>[10-14]</sup> Dashboards can also help to improve clinical decision-making by retrieving and presenting scattered medical information of patients in a single screen, in real time, enhancing the competency, efficacy, and efficiency of decision-making and reducing potential for errors by oversight or missed information.<sup>[10-14]</sup> Dashboards also provide an easily accessible and interpretable visual interface that optimises clinical decision-making.<sup>[10-14]</sup> These benefits of dashboards have led to the development and deployment of dashboards in several areas of patient care including intensive care units.<sup>[10-14]</sup>

Visual analytics are generally used in healthcare to interpret data related to clinical care, scientific research, and financial or administrative data.<sup>[17-22]</sup> Visual analytics have been extensively used to understand data pertaining to clinical care including blood transfusion, medication alerts, and compliance to protocols, collation, and integration of data from multiple EHMRs, visualising outcomes data and enhancing healthcare education.<sup>[23-30]</sup> Anaesthesia Information Management Systems with user interface usability are widely used to generate automated electronic anaesthesia records.<sup>[31-33]</sup>

The concept of a dashboard can also be applied to evaluate quality metrics for the performance of a particular clinical unit focused on metrics pertaining to quality of patient care. In this instance, the dashboard can be designed to provide information pertaining to workflow processes, bed occupancy, transition or change from one procedure to another (e.g., from a local or regional anaesthesia to general anaesthesia, or from a planned normal vaginal delivery to an emergency caesarean section), response times to specific emergencies, and even adherence to clinical management protocols. The dashboard for a unit can thus provide an overall or larger picture of the quality metrics for the efficacy and efficiency of a department beyond information on individual patients. These metrics can provide early warning systems for departments or unit to revisit and address any deficiencies or problems in clinical patient care.

The concept of departmental performance assessment or evaluation is not new. Most, if not all, departments perform regular reviews at different intervals. Some may review on a weekly basis and some on a monthly,

quarterly, half yearly, or even on an annual basis. The inability to identify problems in real time is a disadvantage of reviews at later dates. This delay may impact on the quality of patient care in the interim. The advantage of a dashboard is the ability to audit in real time and to have the results accessible to all pertinent members in a visual interface and at a single central location. Additionally, the use of a departmental performance dashboard can help to highlight specific areas of concern. These areas can be further examined in detail by reviewing appropriate charts and process algorithms.

### ADAPTING THE DASHBOARD CONCEPT TO AUDIT AN OBSTETRIC ANAESTHESIA UNIT

We designed and implemented a simple user-friendly dashboard to provide real-time information to audit the performance of a dedicated obstetric anaesthesia unit in an advanced tertiary care perinatal institute in South India. We focused on few areas pertinent to improved patient care for the development of quality metrics that included around 80 anaesthesia-related variables and subvariables [Tables 1-4]. These included information on labor analgesia, childbirth modes including caesarean sections and assisted vaginal delivery, anaesthesia-related complications and transition from one mode of anaesthesia to another, and use of general anaesthesia and administrative data pertinent to improved patient care. We developed three cutoff criteria for each quality metric—a normal range, mild abnormal range, and abnormal range warranting immediate redressal. The quality metrics and cutoff criteria were chosen by a literature review, review of the departmental statistics for the past 5 years and consensus after discussion with members of the unit and obstetricians at the study institute. The beauty of this unique dashboard is that it allows us to dynamically adjust the cutoffs in various color zones, depending on the performance consistency, hence the departmental standards can aim to perform better than the acceptable defined international standards.

Each cutoff range was color coded for ease of visual interpretation—green for normal ranges, orange

**Table 1: Data pertaining to general statistics of the group**  
**Overall statistics**

Total anaesthetic procedures
Total obstetric procedures
Number of regionals
Number of general anaesthetic procedures

**Table 2: Parameters pertaining to childbirth and labor analgesia**

Category	Parameters	Red Zone	Orange Zone	Green Zone	
Obstetric procedures	Number of deliveries				
	Number of vaginal births				
	Number of SVD				
	Overall AVD (%)	>14	10-14	<10	
	Obstetric procedures				
	Number of labor epidurals				
	LEA acceptance rate (%)	<50	50-65	>65	
	LA/epidural technique (%)	<91	91-98	>98	
	LA/combined spinal epidural analgesia technique (%)	>3	2-3	<2	
	LA/spinal (SAB) (%)	>2	1-2	<1	
	LA to SVD (%)	<50	50-60	>60	
	LA to AVD (%)	>24	18-24	<18	
	LA to LSCS (%)	>24	18-24	<18	
	Failed LA for LSCS—total	>5	2-5	<2	
	SAB ab initio	>4	2-4	<2	
	SAB after failed LEA	>3	2-3	<2	
	Failed LEA to GETA	>2	1-2	0-1	
	Total number of resiting (%)	>10	5-10	<5	
	Resiting due to catheter fallout	>5	3-5	<3	
	Resiting due to inadequate block	>5	3-5	<3	
	Apgar <7 at 5 min in term AGA/ cord Ph <7.2	≥1*		0	
	Obstetric Procedures	LSCS			
LSCS↓RA (%)		<90	90-93	>93	
LSCS↓GETA (%)		>7	5-7	<5	
Cat I LSCS (%)		>8	5-8	<5	
Working LEA gave GETA		>2*	1-2	0-1	

SVD – Spontaneous vaginal deliveries; AVD – Assisted vaginal deliveries; LEA – Labor epidural analgesia; LA – Labor analgesia; SAB – Subarachnoid block; LSCS – Lower segment caesarean section; GETA – General endotracheal anaesthesia; RA – Regional anaesthesia; AGA – Average for Gestational Age \*Denotes unacceptable complication indicating zero tolerance. These should immediately be followed by CAPA with debriefing. CAPA – Corrective action and preventive action;

for mild abnormal ranges, and red for abnormal ranges warranting immediate action. Visual analytic computational tools help to integrate data analysis with active visual interfaces and ease navigation of large amounts of data. Visual analytics tools allow for a rapid visual interpretation of pertinent data, display of large amounts of filtered data in almost real time, and allow users to rapidly identify areas of concern that have to explore further in depth. An effective visual dashboard should display critical information on a single screen, have sparse graphical icons, display context in abbreviated forms, and use different colors and color intensities rather than different hues of the same color.<sup>[18-20,34-36]</sup>

We created the visual dashboard in MS Excel and placed it in a central location easily accessible

by all members of the obstetric anaesthesia team. All parameters are reviewed immediately after an adverse event. Otherwise, the data are reviewed when any parameter enters the amber zone. The excel sheet is entered on a daily basis. Monthly data presentation and discussion with team is mandatory. The dashboard presented information in real time and by month and allowed for comparisons across months and years.

We found several advantages or benefits with the use of the dashboard. The dashboard allowed us to interpret information in almost real time shortening the response time to issues. The visual interface and color codes allowed us to immediately focus on areas of high concern and work out strategies to address those. For example, the dashboard allowed all members to have a visual interpretation on the success or conversion rates from labor analgesia counseling, to have an almost real-time visual interpretation and discuss with the obstetrics team if the rates of caesarean sections were increasing, to identify in almost real times changes in rates of transition from one mode of anaesthesia to another, and overall complication rates across the department. The dashboard also allowed us to perform a focused chart review to identify, study, and troubleshoot problems. The dashboard allowed us to share information with all team members in almost real time and to solicit comments, suggestions, and strategies from all team members. Particularly, the dashboard dynamic review audit has helped the department to think innovatively and reduce common preventable causes of epidural catheter resiting for labor analgesia patients, reduced the incidence of wet taps—PDPH, lead to newer innovative methods to reduce bloody taps, reduced failed regionals for emergency caesarean sections, anticipate and minimise difficult intubations to name a few. The dashboard also made comparisons between months and previous years easier. We chose to use MS Excel over other traditional relational databases since it is widely available and relatively easier to use. We did not have to invest additional resources to train personnel or to obtain specialized software or statistical expertise for this purpose.

**SUMMARY**

There is increasing recognition that perinatal health outcomes in India can only be improved by a multidisciplinary approach and a paradigm shift from

**Table 3: Parameters pertaining to anaesthesia problems**

Category	Parameters	Red Zone	Orange Zone	Green Zone
Central neuraxial blockade	Number of CSEA			
	Number of LEA			
	Number of SAB			
	Overall failed RA	>4%	2-4%	<2%
	Failed CSEA→SAB			
	Failed CSEA→EA			
	Failed CSEA→GA			
	Failed SAB→RPT SAB			
	Failed SAB→GA			
	Blood tap	>7%	4-7%	<4%
Through Tuohy needle	Through catheter			
	Through spinal needle			
	Dry tap with CSEA needle			
High sympathetic block	With single shot spinal	0	0-1%	0
	With spinal after failed LEA			
	With first dose of epidural after uneventful CSEA			
ADP	No. of ADPs	>1%	0.6-1%	<0.6%
	ADP with EA			
	ADP with CSEA			
	ADP - intrathecal catheter			
	ADP - epidural relocated in different space			
	PDPH			
PDPH with EA	PDPH with CSEA			
	Severe PDPH with SAB27/29W	>2%	1-2%	<1%
Severe PDPH after intrathecal catheter	After different space EA			
	PDPH with PRES (posterior reversible encephalopathy syndrome)	1*		0
Conservative management EBP (epidural blood patch)	EBP with long-term sequelae	<60%	60-70%	>70%
	PDPH with long-term sequelae	1*		0
Others	Subdural/Horner's syndrome	1*		0
	Inadvertent intravenous migration	1*		0
	Inadvertent intrathecal migration	1*		0
	Local anaesthetic systemic toxicity/total spinal	1*		0
	Postpartum urinary retention	>2%	1-2%	<1%
	Trapped catheter	1*		0
	Transient neurological symptoms	1*		0
	Long-term backache following CNB	1*		0
	Neurological symptoms unrelated to anaesthesia	1*		0

Contd...

**Table 3: Contd...**

Category	Parameters	Red Zone	Orange Zone	Green Zone
Major neurological sequelae due to anaesthesia	Unplanned ventilator support/ICU care	1*		0
	LMA/ETT			
GA	Following failed CNB	>2%		<1%
	Following surgical problem	>2%		<1%
	Unanticipated difficult intubation	>1%		0
	Cannot intubate cannot ventilate/intubating LMA	1*		0
	Intubating/proseal LMA rescue	1*		0
	Fiber optic intubation/front of neck access			
	LMA to ETT - Surg/LMA problem	1*		0
	Aspiration	1*		0

\*Denotes unacceptable complication indicating zero tolerance. These should immediately be followed by CAPA with debriefing. CAPA – Corrective action and preventive action; CSEA – Combined spinal epidural anaesthesia; LEA – Labor epidural analgesia; SAB – Subarachnoid block; ADPs – Accidental dural punctures; EA – Epidural analgesia; PDPH – Post-dural-puncture headache; CNB – Central neuraxial block; LMA – Laryngeal mask airway; ICU – Intensive care units; ETT – Endotracheal tube; GA – General anaesthesia; RPT – Repeat; RA – Regional anaesthesia; → – converted to

**Table 4: Administrative data collected as part of the dashboard**

Parameters	Red Zone	Orange Zone	Green Zone
Anaesthesia-related readmission/prolonged hospital stay	≥1*		0
Difficult technique/change of hands	>3	1-3	<1
Percentage attendance in classes	<40	40-70	>70
Percentage classes cancelled	>10	5-10	<5

\*Denotes unacceptable complication indicating zero tolerance. These should immediately be followed by CAPA with debriefing. CAPA – Corrective Action and Preventive Action

an approach focused only on an obstetrics-pediatrician care axis. Several clinical disciplines including intensivists, radiologists, nutritionists, and anaesthesiologists are actively involved in care for each pregnant woman. The role of the obstetric anaesthesiologist is gaining more importance as institutional deliveries and competence, acceptance, and use of caesarean sections is increasing. The expanding role also necessitates the development and deployment of appropriate quality checks and audit processes with an aim to improve patient care and safety, increase efficiency, optimize resource allocation and utilisation, and enhance clinical, departmental, and organisational decision-making. The use of a simple yet pertinent dashboard can help greatly to optimise performance of obstetric anaesthesia teams in India.

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There are no conflicts of interest.

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